

Reference Tables for Chemistry

A

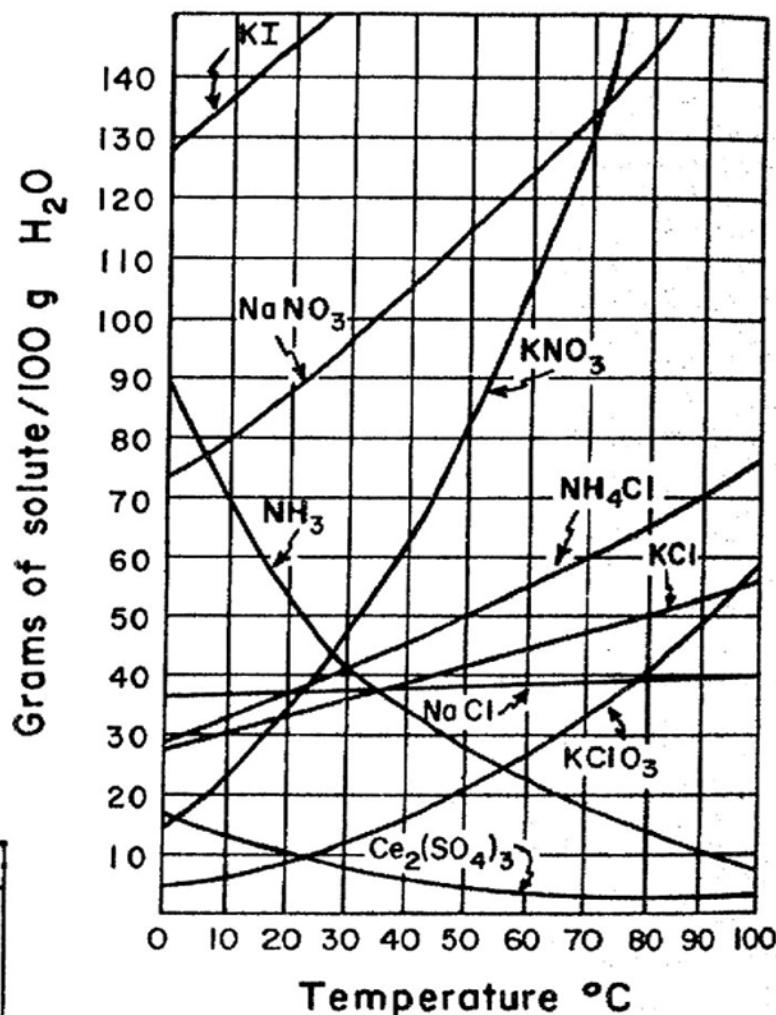
DENSITY AND BOILING POINTS
OF SOME COMMON GASES

Name		Density grams/liter at STP*	Boiling Point (at 1 atm) K
Air	—	1.29	—
Ammonia	NH ₃	0.771	240
Carbon dioxide	CO ₂	1.98	195
Carbon monoxide	CO	1.25	82
Chlorine	Cl ₂	3.21	172
Hydrogen	H ₂	0.0899	20
Hydrogen chloride	HCl	1.64	188
Hydrogen sulfide	H ₂ S	1.54	212
Methane	CH ₄	0.714	109
Nitrogen	N ₂	1.25	77
Nitrogen (II) oxide	NO	1.34	121
Oxygen	O ₂	1.43	90
Sulfur dioxide	SO ₂	2.93	263

*STP is defined as 273K or 0°C and 1 atm or 760 torr

B

SOLUBILITY CURVES



C

TABLE OF SOLUBILITIES IN WATER

	acetate	bromide	carbonate	chloride	chromate	hydroxide	iodide	nitrate	phosphate	sulfate	sulfide
i — nearly insoluble											
ss — slightly soluble											
s — soluble											
d — decomposes											
n — not isolated											
Aluminum	ss	s	n	s	n	i	s	s	i	s	d
Ammonium	s	s	s	s	s	s	s	s	s	s	s
Barium	s	s	i	s	i	s	s	s	i	i	d
Calcium	s	s	i	s	s	ss	s	s	i	ss	d
Copper II	s	s	i	s	i	i	d	s	i	s	i
Iron II	s	s	i	s	n	i	s	s	i	s	i
Iron III	s	s	n	s	i	i	n	s	i	ss	d
Lead	s	ss	i	ss	i	i	ss	s	i	i	i
Magnesium	s	s	i	s	s	i	s	s	i	s	d
Mercury I	ss	i	i	i	ss	n	i	s	i	ss	i
Mercury II	s	ss	i	s	ss	i	i	s	i	d	i
Potassium	s	s	s	s	s	s	s	s	s	s	s
Silver	ss	i	i	i	ss	n	i	s	i	ss	i
Sodium	s	s	s	s	s	s	s	s	s	s	s
Zinc	s	s	i	s	s	i	s	s	i	s	i

D

SELECTED POLYATOMIC IONS

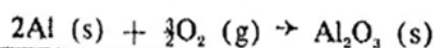
CH ₃ COO ⁻	acetate	MnO ₄ ⁻	permanganate
CN ⁻	cyanide	MnO ₄ ²⁻	manganate
CO ₃ ²⁻	carbonate	NH ₄ ⁺	ammonium
HCO ₃ ⁻	hydrogen carbonate	NO ₂ ⁻	nitrite
C ₂ O ₄ ²⁻	oxalate	NO ₃ ⁻	nitrate
ClO ⁻	hypochlorite	OH ⁻	hydroxide
ClO ₂ ⁻	chlorite	PO ₄ ³⁻	phosphate
ClO ₃ ⁻	chlorate	SCN ⁻	thiocyanate
ClO ₄ ⁻	perchlorate	SO ₃ ²⁻	sulfite
CrO ₄ ²⁻	chromate	SO ₄ ²⁻	sulfate
Cr ₂ O ₇ ²⁻	dichromate	HSO ₄ ⁻	hydrogen sulfate
Hg ₂ ²⁺	mercury (I)	S ₂ O ₃ ²⁻	thiosulfate

E

Standard Energies of Formation of Compounds at 1 atm and 298 K

Compound	Heat (Enthalpy) of Formation kcal/mole (ΔH_f°)	Free Energy of Formation kcal/mole (ΔG_f°)
Aluminum oxide Al_2O_3 (s)	-399.1	-376.8
Ammonia NH_3 (g)	-11.0	-4.0
Barium sulfate BaSO_4 (s)	-350.2	-323.4
Calcium hydroxide $\text{Ca}(\text{OH})_2$ (s)	-235.8	-214.3
Carbon dioxide CO_2 (g)	-94.1	-94.3
Carbon monoxide CO (g)	-26.4	-32.8
Copper (II) sulfate CuSO_4 (s)	-184.0	-158.2
Ethane C_2H_6 (g)	-20.2	-7.9
Ethene C_2H_4 (g)	12.5	16.3
Ethyne (acetylene) C_2H_2 (g)	54.2	50.0
Hydrogen fluoride HF (g)	-64.2	-64.7
Hydrogen iodide HI (g)	6.2	0.3
Iodine chloride ICl (g)	4.2	-1.3
Lead (II) oxide PbO (s)	-52.4	-45.3
Magnesium oxide MgO (s)	-143.8	-136.1
Nitrogen (II) oxide NO (g)	21.6	20.7
Nitrogen (IV) oxide NO_2 (g)	8.1	12.4
Potassium chloride KCl (s)	-104.2	-97.6
Sodium chloride NaCl (s)	-98.2	-91.8
Sulfur dioxide SO_2 (g)	-71.0	-71.8
Water H_2O (g)	-57.8	-54.6
Water H_2O (l)	-68.3	-56.7

Sample equation



F

SELECTED RADIOISOTOPES

Nuclide	Half-Life	Particle Emission
^{14}C	5730 y	β^-
^{60}Co	5.3 y	β^-
^{137}Cs	30.23 y	β^-
^{220}Fr	27.5 s	α
^3H	12.26 y	β^-
^{131}I	8.07 d	β^-
^{40}K	1.28×10^9 y	β^+
^{42}K	12.4 h	β^-
^{32}P	14.3 d	β^-
^{226}Ra	1600 y	α
^{90}Sr	28.1 y	β^-
^{235}U	7.1×10^8 y	α
^{238}U	4.51×10^9 y	α

y = years; d = days; h = hours; s = seconds

G

Heats of Reaction at 1 atm and 298K

Reaction	ΔH (kcal)
$\text{CH}_4 \text{ (g)} + 2\text{O}_2 \text{ (g)} \rightarrow \text{CO}_2 \text{ (g)} + 2\text{H}_2\text{O (l)}$	-212.8
$\text{C}_3\text{H}_8 \text{ (g)} + 5\text{O}_2 \text{ (g)} \rightarrow 3\text{CO}_2 \text{ (g)} + 4\text{H}_2\text{O (l)}$	-530.6
$\text{CH}_3\text{OH (l)} + \frac{3}{2}\text{O}_2 \text{ (g)} \rightarrow \text{CO}_2 \text{ (g)} + 2\text{H}_2\text{O (l)}$	-173.6
$\text{C}_6\text{H}_{12}\text{O}_6 \text{ (s)} + 6\text{O}_2 \text{ (g)} \rightarrow 6\text{CO}_2 \text{ (g)} + 6\text{H}_2\text{O (l)}$	-669.9
$\text{CO (g)} + \frac{1}{2}\text{O}_2 \text{ (g)} \rightarrow \text{CO}_2 \text{ (g)}$	-67.7
$\text{NaOH (s)} \xrightarrow{\text{H}_2\text{O}} \text{Na}^+ \text{ (aq)} + \text{OH}^- \text{ (aq)}$	-10.6
$\text{NH}_4\text{Cl (s)} \xrightarrow{\text{H}_2\text{O}} \text{NH}_4^+ \text{ (aq)} + \text{Cl}^- \text{ (aq)}$	+3.5
$\text{H}^+ \text{ (aq)} + \text{OH}^- \text{ (aq)} \rightarrow \text{H}_2\text{O (l)}$	-13.8

H

SYMBOLS USED IN NUCLEAR CHEMISTRY

electron	$^0_{-1}\text{e}$	β^-
positron	$^0_{+1}\text{e}$	β^+
proton	^1_1H	p
alpha particle	^4_2He	α
neutron	^1_0n	n
gamma radiation		γ

I

Ionization Energies and Electronegativities

First Ionization Energy (kcal/mole of atoms)								0
IA	IIA	IIIA	IVA	VA	VIA	VIIA		He
313								567
H								He
2.1								
124	215	191	260	336	314	402		497
Li	Be	B	C	N	O	F		Ne
1.0	1.5	2.0	2.5	3.0	3.5	4.0		
119	176	138	188	254	239	300		363
Na	Mg	Al	Si	P	S	Cl		Ar
0.9	1.2	1.5	1.8	2.1	2.5	3.0		
100	141	138	187	231	225	273		323
K	Ca	Ga	Ge	As	Se	Br		Kr
0.8	1.0	1.6	1.8	2.0	2.4	2.8		
96	131	133	169	199	208	241		280
Rb	Sr	In	Sn	Sb	Te	I		Xe
0.8	1.0	1.7	1.8	1.9	2.1	2.5		
90	120	141	171	185				248
Cs	Ba	Tl	Pb	Bi	Po	At		Rn
0.7	0.9	1.8	1.8	1.9	2.0	2.2		
Fr	Ra							
0.7								

J

RELATIVE STRENGTHS OF ACIDS IN AQUEOUS SOLUTION at 1 atm AND 298 K

Conjugate Pairs		K_a
ACID	BASE	
$\text{HI} \rightarrow \text{H}^+ + \text{I}^-$		very large
$\text{HBr} \rightarrow \text{H}^+ + \text{Br}^-$		very large
$\text{HCl} \rightarrow \text{H}^+ + \text{Cl}^-$		very large
$\text{HNO}_3 \rightarrow \text{H}^+ + \text{NO}_3^-$		very large
$\text{H}_2\text{SO}_4 \rightarrow \text{H}^+ + \text{HSO}_4^-$		large
$\text{H}_2\text{O} + \text{SO}_2 \rightarrow \text{H}^+ + \text{HSO}_3^-$		1.7×10^{-2}
$\text{HSO}_4^- \rightarrow \text{H}^+ + \text{SO}_4^{2-}$		1.3×10^{-2}
$\text{H}_3\text{PO}_4 \rightarrow \text{H}^+ + \text{H}_2\text{PO}_4^-$		7.1×10^{-3}
$\text{Fe}(\text{H}_2\text{O})_6^{3+} \rightarrow \text{H}^+ + \text{Fe}(\text{H}_2\text{O})_5(\text{OH})^{2+}$		6.0×10^{-3}
$\text{HF} \rightarrow \text{H}^+ + \text{F}^-$		6.7×10^{-4}
$\text{HNO}_2 \rightarrow \text{H}^+ + \text{NO}_2^-$		5.1×10^{-4}
$\text{Cr}(\text{H}_2\text{O})_6^{3+} \rightarrow \text{H}^+ + \text{Cr}(\text{H}_2\text{O})_5(\text{OH})^{2+}$		1.0×10^{-4}
$\text{CH}_3\text{COOH} \rightarrow \text{H}^+ + \text{CH}_3\text{COO}^-$		1.8×10^{-5}
$\text{Al}(\text{H}_2\text{O})_6^{3+} \rightarrow \text{H}^+ + \text{Al}(\text{H}_2\text{O})_5(\text{OH})^{2+}$		1.0×10^{-5}
$\text{H}_2\text{O} + \text{CO}_2 \rightarrow \text{H}^+ + \text{HCO}_3^-$		4.4×10^{-7}
$\text{H}_2\text{S} \rightarrow \text{H}^+ + \text{HS}^-$		1.0×10^{-7}
$\text{H}_2\text{PO}_4^- \rightarrow \text{H}^+ + \text{HPO}_4^{2-}$		6.3×10^{-8}
$\text{HSO}_3^- \rightarrow \text{H}^+ + \text{SO}_3^{2-}$		6.2×10^{-8}
$\text{NH}_4^+ \rightarrow \text{H}^+ + \text{NH}_3$		5.7×10^{-10}
$\text{HCO}_3^- \rightarrow \text{H}^+ + \text{CO}_3^{2-}$		4.7×10^{-11}
$\text{HPO}_4^{2-} \rightarrow \text{H}^+ + \text{PO}_4^{3-}$		4.4×10^{-13}
$\text{HS}^- \rightarrow \text{H}^+ + \text{S}^{2-}$		1.3×10^{-13}
$\text{H}_2\text{O} \rightarrow \text{H}^+ + \text{OH}^-$		1.0×10^{-14}
$\text{OH}^- \rightarrow \text{H}^+ + \text{O}^{2-}$		$< 10^{-30}$
$\text{NH}_3 \rightarrow \text{H}^+ + \text{NH}_2^-$		very small

K

Constants for Various Equilibria at 1 atm and 298 K

$\text{H}_2\text{O} = \text{H}^+(\text{aq}) + \text{OH}^-(\text{aq})$		$K_w = 1.0 \times 10^{-14}$
$\text{CH}_3\text{COO}^-(\text{aq}) + \text{H}_2\text{O} = \text{CH}_3\text{COOH}(\text{aq}) + \text{OH}^-(\text{aq})$		$K_b = 5.6 \times 10^{-10}$
$\text{NH}_3(\text{aq}) + \text{H}_2\text{O} = \text{NH}_4^+(\text{aq}) + \text{OH}^-(\text{aq})$		$K_b = 1.8 \times 10^{-5}$
$\text{CO}_3^{2-}(\text{aq}) + \text{H}_2\text{O} = \text{HCO}_3^-(\text{aq}) + \text{OH}^-(\text{aq})$		$K_b = 2.1 \times 10^{-4}$
$\text{Ag}(\text{NH}_3)_2^+(\text{aq}) = \text{Ag}^+(\text{aq}) + 2\text{NH}_3(\text{aq})$		$K_{eq} = 6.3 \times 10^{-8}$
$\text{N}_2(\text{g}) + 3\text{H}_2(\text{g}) = 2\text{NH}_3(\text{g})$		$K_{eq} = 6.7 \times 10^5$
$\text{H}_2(\text{g}) + \text{I}_2(\text{g}) = 2\text{HI}(\text{g})$		$K_{eq} = 3.5 \times 10^{-1}$

Compound	K_{sp}	Compound	K_{sp}
AgCl	1.6×10^{-10}	PbCl ₂	1.6×10^{-8}
AgBr	7.7×10^{-13}	PbCrO ₄	1.8×10^{-14}
AgI	1.5×10^{-10}	PbI ₂	1.4×10^{-8}
BaSO ₄	1.1×10^{-10}	ZnS	1.6×10^{-23}

L

STANDARD ELECTRODE POTENTIALS

Ionic Concentrations 1 M Water at 298 K, 1 atm

Half-Reaction	E° (volts)
$F_2(g) + 2e^- \rightarrow 2F^-$	+2.87
$MnO_4^- + 8H^+ + 5e^- \rightarrow Mn^{2+} + 4H_2O$	+1.52
$Au^{3+} + 3e^- \rightarrow Au(s)$	+1.50
$Cl_2(g) + 2e^- \rightarrow 2Cl^-$	+1.36
$Cr_2O_7^{2-} + 14H^+ + 6e^- \rightarrow 2Cr^{3+} + 7H_2O$	+1.33
$MnO_2(s) + 4H^+ + 2e^- \rightarrow Mn^{2+} + 2H_2O$	+1.28
$\frac{1}{2}O_2(g) + 2H^+ + 2e^- \rightarrow H_2O$	+1.23
$Br_2(l) + 2e^- \rightarrow 2Br^-$	+1.06
$NO_3^- + 4H^+ + 3e^- \rightarrow NO(g) + 2H_2O$	+0.96
$\frac{1}{2}O_2(g) + 2H^+(10^{-7}M) + 2e^- \rightarrow H_2O$	+0.82
$Ag^+ + e^- \rightarrow Ag(s)$	+0.80
$\frac{1}{2}Hg_2^{2+} + e^- \rightarrow Hg(l)$	+0.79
$Hg^{2+} + 2e^- \rightarrow Hg(l)$	+0.78
$NO_3^- + 2H^+ + e^- \rightarrow NO_2(g) + H_2O$	+0.78
$Fe^{3+} + e^- \rightarrow Fe^{2+}$	+0.77
$I_2(s) + 2e^- \rightarrow 2I^-$	+0.53
$Cu^+ + e^- \rightarrow Cu(s)$	+0.52
$Cu^{2+} + 2e^- \rightarrow Cu(s)$	+0.34
$SO_4^{2-} + 4H^+ + 2e^- \rightarrow SO_2(g) + 2H_2O$	+0.17
$Sn^{4+} + 2e^- \rightarrow Sn^{2+}$	+0.15
$2H^+ + 2e^- \rightarrow H_2(g)$	0.00
$Pb^{2+} + 2e^- \rightarrow Pb(s)$	-0.13
$Sn^{2+} + 2e^- \rightarrow Sn(s)$	-0.14
$Ni^{2+} + 2e^- \rightarrow Ni(s)$	-0.25
$Co^{2+} + 2e^- \rightarrow Co(s)$	-0.28
$2H^+(10^{-7}M) + 2e^- \rightarrow H_2(g)$	-0.41
$Fe^{2+} + 2e^- \rightarrow Fe(s)$	-0.44
$Cr^{3+} + 3e^- \rightarrow Cr(s)$	-0.74
$Zn^{2+} + 2e^- \rightarrow Zn(s)$	-0.76
$2H_2O + 2e^- \rightarrow 2OH^- + H_2(g)$	-0.83
$Mn^{2+} + 2e^- \rightarrow Mn(s)$	-1.18
$Al^{3+} + 3e^- \rightarrow Al(s)$	-1.66
$Mg^{2+} + 2e^- \rightarrow Mg(s)$	-2.37
$Na^+ + e^- \rightarrow Na(s)$	-2.71
$Ca^{2+} + 2e^- \rightarrow Ca(s)$	-2.87
$Sr^{2+} + 2e^- \rightarrow Sr(s)$	-2.89
$Ba^{2+} + 2e^- \rightarrow Ba(s)$	-2.90
$Cs^+ + e^- \rightarrow Cs(s)$	-2.92
$K^+ + e^- \rightarrow K(s)$	-2.92
$Rb^+ + e^- \rightarrow Rb(s)$	-2.93
$Li^+ + e^- \rightarrow Li(s)$	-3.00

M

PHYSICAL CONSTANTS

Name	Symbol	Values
Speed of light	c	3.00×10^8 meters/sec
Avogadro number	N_A	6.02×10^{23} per mole
Universal Gas Constant	R	$\begin{cases} 0.0821 \text{ liter} \cdot \text{atm} / \text{mole} \cdot \text{K} \\ 1.99 \text{ cal} / \text{mole} \cdot \text{K} \\ 8.31 \text{ joule} / \text{mole} \cdot \text{K} \end{cases}$
Planck's Constant	h	6.63×10^{-34} joule·sec
Charge of electron	e	1.60×10^{-19} coulomb
Molal freezing point depression constant for $H_2O = 1.86^\circ C$		
Molal boiling point elevation constant for $H_2O = 0.52^\circ C$		
Atomic Mass Unit	1 amu	$= 1.66 \times 10^{-24}$ g
Heat Equivalent	1 kcal	$= 4.19 \times 10^3$ joule
Volume Standard	1 liter	$= 1.00 \times 10^3$ cm ³
Angstrom Unit	1 Å	$= 1.00 \times 10^{-10}$ meter
Electron Volt	1 ev	$= 1.60 \times 10^{-19}$ joule

N

VAPOR PRESSURE OF WATER

$^\circ C$	torr (mm Hg)	$^\circ C$	torr (mm Hg)
0	4.6	26	25.2
5	6.5	27	26.7
10	9.2	28	28.3
15	12.8	29	30.0
16	13.6	30	31.8
17	14.5	40	55.3
18	15.5	50	92.5
19	16.5	60	149.4
20	17.5	70	233.7
21	18.7	80	355.1
22	19.8	90	525.8
23	21.1	100	760.0
24	22.4	105	906.1
25	23.8	110	1074.6

Periodic Table of the Elements

Relative atomic mass
 $^{12}\text{C} = 12.0000$

Period	IA	IIA	Transition Elements									
1	<div> <div>1.00797</div> <div>+1</div> <div>-1</div> <div>1</div> <div>H</div> <div>0.32</div> <div>1s¹</div> </div>											
2	<div> <div>6.939</div> <div>+1</div> <div></div> <div>3</div> <div>Li</div> <div>1.23</div> <div>1s²2s¹</div> </div>	<div> <div>9.0122</div> <div>+2</div> <div></div> <div>4</div> <div>Be</div> <div>0.89</div> <div>1s²2s²</div> </div>									<div> <div>KEY</div> <div>Atomic Mass(Weight) → 12.01115</div> <div>Symbol → C</div> <div>Atomic Number → 6</div> <div>Electron Configuration → 1s² 2s² 2p²</div> <div>Selected (→ -4, +2, +4)</div> <div>Covalent (→ 0.77)</div> </div>	
3	<div> <div>22.9898</div> <div>+1</div> <div></div> <div>11</div> <div>Na</div> <div>1.54</div> <div>[Ne] 3s¹</div> </div>	<div> <div>24.312</div> <div>+2</div> <div></div> <div>12</div> <div>Mg</div> <div>1.36</div> <div>[Ne] 3s²</div> </div>	GROUPS									
4	<div> <div>39.102</div> <div>+1</div> <div></div> <div>19</div> <div>K</div> <div>2.03</div> <div>[Ar] 4s¹</div> </div>	<div> <div>40.08</div> <div>+2</div> <div></div> <div>20</div> <div>Ca</div> <div>1.74</div> <div>[Ar] 4s²</div> </div>	<div> <div>44.956</div> <div>+3</div> <div></div> <div>21</div> <div>Sc</div> <div>1.44</div> <div>[Ar] 3d¹4s²</div> </div>	<div> <div>47.90</div> <div>+2</div> <div>+3</div> <div>+4</div> <div>22</div> <div>Ti</div> <div>1.32</div> <div>[Ar] 3d²4s²</div> </div>	<div> <div>50.942</div> <div>+2</div> <div>+3</div> <div>+4</div> <div>+5</div> <div>23</div> <div>V</div> <div>1.22</div> <div>[Ar] 3d³4s²</div> </div>	<div> <div>51.996</div> <div>+2</div> <div>+3</div> <div>+4</div> <div>+6</div> <div>24</div> <div>Cr</div> <div>1.18</div> <div>[Ar] 3d⁵4s¹</div> </div>	<div> <div>54.9380</div> <div>+2</div> <div>+3</div> <div>+4</div> <div>+7</div> <div>25</div> <div>Mn</div> <div>1.17</div> <div>[Ar] 3d⁵4s²</div> </div>	<div> <div>55.847</div> <div>+2</div> <div>+3</div> <div></div> <div>26</div> <div>Fe</div> <div>1.17</div> <div>[Ar] 3d⁶4s²</div> </div>	<div> <div>58.9332</div> <div>+2</div> <div>+3</div> <div>+4</div> <div>27</div> <div>Co</div> <div>1.16</div> <div>[Ar] 3d⁷4s²</div> </div>	VIII		
5	<div> <div>85.47</div> <div>+1</div> <div></div> <div>37</div> <div>Rb</div> <div>2.16</div> <div>[Kr] 5s¹</div> </div>	<div> <div>87.62</div> <div>+2</div> <div></div> <div>38</div> <div>Sr</div> <div>1.91</div> <div>[Kr] 5s²</div> </div>	<div> <div>88.905</div> <div>+3</div> <div></div> <div>39</div> <div>Y</div> <div>1.62</div> <div>[Kr] 4d¹5s²</div> </div>	<div> <div>91.22</div> <div>+4</div> <div></div> <div>40</div> <div>Zr</div> <div>1.45</div> <div>[Kr] 4d²5s²</div> </div>	<div> <div>92.906</div> <div>+3</div> <div>+5</div> <div></div> <div>41</div> <div>Nb</div> <div>1.34</div> <div>[Kr] 4d⁴5s¹</div> </div>	<div> <div>95.94</div> <div>+3</div> <div>+6</div> <div></div> <div>42</div> <div>Mo</div> <div>1.30</div> <div>[Kr] 4d⁵5s¹</div> </div>	<div> <div>98.9062</div> <div>+4</div> <div>+6</div> <div>+7</div> <div>43</div> <div>Tc</div> <div>1.27</div> <div>[Kr] 4d⁵5s¹</div> </div>	<div> <div>101.07</div> <div>+3</div> <div></div> <div>44</div> <div>Ru</div> <div>1.25</div> <div>[Kr] 4d⁷5s¹</div> </div>	<div> <div>102.505</div> <div>+3</div> <div>+4</div> <div></div> <div>45</div> <div>Rh</div> <div>1.25</div> <div>[Kr] 4d⁸5s¹</div> </div>			
6	<div> <div>132.905</div> <div>+1</div> <div></div> <div>55</div> <div>Cs</div> <div>2.35</div> <div>[Xe] 6s¹</div> </div>	<div> <div>137.34</div> <div>+2</div> <div></div> <div>56</div> <div>Ba</div> <div>1.98</div> <div>[Xe] 6s²</div> </div>	<div> <div>138.91</div> <div>+3</div> <div></div> <div>57</div> <div>La</div> <div>1.69</div> <div>[Xe] 5d¹6s²</div> </div>	<div> <div>178.49</div> <div>+4</div> <div></div> <div>72</div> <div>Hf</div> <div>1.44</div> <div>[Xe] 4f¹⁴5d²6s²</div> </div>	<div> <div>180.948</div> <div>+5</div> <div></div> <div>73</div> <div>Ta</div> <div>1.34</div> <div>[Xe] 4f¹⁴5d³6s²</div> </div>	<div> <div>183.85</div> <div>+6</div> <div></div> <div>74</div> <div>W</div> <div>1.30</div> <div>[Xe] 4f¹⁴5d⁴6s²</div> </div>	<div> <div>186.2</div> <div>+4</div> <div>+6</div> <div>+7</div> <div>75</div> <div>Re</div> <div>1.28</div> <div>[Xe] 4f¹⁴5d⁵6s²</div> </div>	<div> <div>190.2</div> <div>+3</div> <div>+4</div> <div></div> <div>76</div> <div>Os</div> <div>1.26</div> <div>[Xe] 4f¹⁴5d⁶6s²</div> </div>	<div> <div>192.2</div> <div>+3</div> <div>+4</div> <div></div> <div>77</div> <div>Ir</div> <div>1.27</div> <div>[Xe] 4f¹⁴5d⁷6s²</div> </div>			
7	<div> <div>(223)</div> <div>+1</div> <div></div> <div>87</div> <div>Fr</div> <div></div> <div>[Rn] 7s¹</div> </div>	<div> <div>(226)</div> <div>+2</div> <div></div> <div>88</div> <div>Ra</div> <div>2.20</div> <div>[Rn] 7s²</div> </div>	<div> <div>(227)</div> <div>+3</div> <div></div> <div>89</div> <div>Ac</div> <div>2.0</div> <div>[Rn] 6d¹7s²</div> </div>	104	105							

KEY

Atomic Mass (Weight) → 12.01115

Symbol → **C**

Atomic Number → 6

Electron Configuration → 1s² 2s² 2p²

Selected (oxidation states) → -4, +2, +4

Covalent radius → 0.77

Numbers in parentheses are mass numbers of most stable or most common isotope.

Lanthanide Series

Actinide Series

Ce 58 140.12 [Xe] 4f ¹ 5d ¹ 6s ²	Pr 59 140.907 [Xe] 4f ³ 6s ²	Nd 60 144.24 [Xe] 4f ⁴ 6s ²	Pm 61 (145) [Xe] 4f ⁵ 6s ²	Sm 62 150.35 [Xe] 4f ⁶ 6s ²	Eu 63 151.96 [Xe] 4f ⁷ 6s ²	Gd 64 157.25 [Xe] 4f ⁷ 5d ¹ 6s ²
Th 90 232.038 [Rn] 6d ² 7s ²	Pa 91 231.036 [Rn] 5f ² 6d ¹ 7s ²	U 92 238.03 [Rn] 5f ³ 6d ¹ 7s ²	Np 93 237.048 [Rn] 5f ⁴ 6d ¹ 7s ²	Pu 94 (244) [Rn] 5f ⁶ 7s ²	Am 95 (243) [Rn] 5f ⁷ 7s ²	Cm 96 (247) [Rn] 5f ⁷ 6d ¹ 7s ²

Elements

relative atomic masses are based on
= 12.00000

— Selected Oxidation States

— Covalent Atomic Radius (Å)

GROUPS

IIIA

IVA

VA

VIA

VIIA

0

VIII

IB

IIB

— Covalent Atomic Radius (Å)										GROUPS					4.0026								
										IIIA	IVA	VA	VIA	VIIA	2	0.31							
										10.811	+3	12.01115	-4	+2	+4	14.0067	-3	-2	-1	20.183	0		
										5	0.82	6	0.77	7	0.75	8	0.73	9	0.72	10	0.71		
										1s ² 2s ² 2p ¹		1s ² 2s ² 2p ²		1s ² 2s ² 2p ³		1s ² 2s ² 2p ⁴		1s ² 2s ² 2p ⁵		1s ² 2s ² 2p ⁶			
										26.9815	+3	28.086	-4	+2	+4	30.9738	-3	+3	+5	32.064	-2	+4	+6
										13	1.18	14	1.11	15	1.06	16	1.02	17	0.99	18	0.98		
										[Ne] 3s ² 3p ¹		[Ne] 3s ² 3p ²		[Ne] 3s ² 3p ³		[Ne] 3s ² 3p ⁴		[Ne] 3s ² 3p ⁵		[Ne] 3s ² 3p ⁶			
VIII										IB	IIB												
58.9332	58.71	63.54	65.37	69.72	72.59	74.9216	78.96	79.909	83.80														
27	28	29	30	31	32	33	34	35	36														
[Ar] 3d ⁷ 4s ²	[Ar] 3d ⁸ 4s ²	[Ar] 3d ¹⁰ 4s ¹	[Ar] 3d ¹⁰ 4s ²	[Ar] 3d ¹⁰ 4s ² 4p ¹	[Ar] 3d ¹⁰ 4s ² 4p ²	[Ar] 3d ¹⁰ 4s ² 4p ³	[Ar] 3d ¹⁰ 4s ² 4p ⁴	[Ar] 3d ¹⁰ 4s ² 4p ⁵	[Ar] 3d ¹⁰ 4s ² 4p ⁶														
102.905	106.4	107.870	112.40	114.82	118.69	121.75	127.60	126.9044	131.30														
45	46	47	48	49	50	51	52	53	54														
[Kr] 4d ⁸ 5s ¹	[Kr] 4d ¹⁰ 5s ⁰	[Kr] 4d ¹⁰ 5s ¹	[Kr] 4d ¹⁰ 5s ²	[Kr] 4d ¹⁰ 5s ² 5p ¹	[Kr] 4d ¹⁰ 5s ² 5p ²	[Kr] 4d ¹⁰ 5s ² 5p ³	[Kr] 4d ¹⁰ 5s ² 5p ⁴	[Kr] 4d ¹⁰ 5s ² 5p ⁵	[Kr] 4d ¹⁰ 5s ² 5p ⁶														
192.22	195.09	196.967	200.59	204.37	207.19	208.980	(209)	(210)	(222)														
77	78	79	80	81	82	83	84	85	86														
[Xe] 4f ¹⁴ 5d ⁸ 6s ¹	[Xe] 4f ¹⁴ 5d ⁹ 6s ¹	[Xe] 4f ¹⁴ 5d ¹⁰ 6s ¹	[Xe] 4f ¹⁴ 5d ¹⁰ 6s ²	[Xe] 4f ¹⁴ 5d ¹⁰ 6s ² 6p ¹	[Xe] 4f ¹⁴ 5d ¹⁰ 6s ² 6p ²	[Xe] 4f ¹⁴ 5d ¹⁰ 6s ² 6p ³	[Xe] 4f ¹⁴ 5d ¹⁰ 6s ² 6p ⁴	[Xe] 4f ¹⁴ 5d ¹⁰ 6s ² 6p ⁵	[Xe] 4f ¹⁴ 5d ¹⁰ 6s ² 6p ⁶														

<div>157.25</div> <div>Gd</div> <div>64</div> <div>1.62</div> <div>(247)</div>	<div>158.924</div> <div>Tb</div> <div>65</div> <div>1.61</div> <div>(247)</div>	<div>162.50</div> <div>Dy</div> <div>66</div> <div>1.60</div> <div>(251)</div>	<div>164.930</div> <div>Ho</div> <div>67</div> <div>1.58</div> <div>(254)</div>	<div>167.26</div> <div>Er</div> <div>68</div> <div>1.58</div> <div>(257)</div>	<div>168.934</div> <div>Tm</div> <div>69</div> <div>1.58</div> <div>(256)</div>	<div>173.04</div> <div>Yb</div> <div>70</div> <div>1.70</div> <div>(254)</div>	<div>174.97</div> <div>Lu</div> <div>71</div> <div>1.56</div> <div>(257)</div>
<div>(247)</div> <div>Gm</div> <div>96</div> <div></div>	<div>(247)</div> <div>Bk</div> <div>97</div> <div></div>	<div>(251)</div> <div>Cf</div> <div>98</div> <div></div>	<div>(254)</div> <div>Es</div> <div>99</div> <div></div>	<div>(257)</div> <div>Fm</div> <div>100</div> <div></div>	<div>(256)</div> <div>Md</div> <div>101</div> <div></div>	<div>(254)</div> <div>No</div> <div>102</div> <div></div>	<div>(257)</div> <div>Lr</div> <div>103</div> <div></div>